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(71) Applicant: <b>METAGENICS, INC. [US/US]; 971 Calle Negocio, San Clemente, CA 92672 (US).</b>		
(72) Inventor: <b>PAUL, Stephen, M.; 16 Optima, San Clemente, CA 92672 (US).</b>		
(74) Agents: <b>CLAYTON, Grant, R. et al.; Thorpe, North &amp; Western, Suite 200, 9035 South 700 East, Sandy, UT 84070 (US).</b>		

(54) Title: COMPOSITIONS AND METHODS FOR HUMAN GASTROINTESTINAL HEALTH

## (57) Abstract

A composition for promoting gastrointestinal health comprises an effective amount of a beneficial human intestinal microorganism and an effective amount of an immunoglobulin composition comprising concentrated immunologically active immunoglobulins. Another composition for restoring and maintaining gastrointestinal health comprises 40-60 % by weight of an immunoglobulin composition comprising concentrated immunologically active immunoglobulins and 40-60 % by weight of soluble dietary fiber selected from inulin, fructo-oligosaccharides, pectin, guar gum, and mixtures thereof. The immunoglobulin and fiber-containing composition can optionally contain one or more of a beneficial human intestinal microorganism, components of a non-immune natural defense system, an iron-sequestering molecule, and gluconic acid. Preferred beneficial human intestinal microorganisms include lactobacilli and bifidobacteria. The immunologically active immunoglobulins are preferably purified from bovine milk, milk products, or whey. Methods of use are also described.

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**COMPOSITIONS AND METHODS FOR HUMAN  
GASTROINTESTINAL HEALTH**Background of the Invention

10        This invention relates to compositions and methods  
for promoting gastrointestinal health. More  
particularly, the invention relates to a composition  
comprising (a) an immunoglobulin preparation containing  
immunoglobulins that are capable of binding and  
inactivating foreign antigens such as pathogenic  
15        bacteria, viruses, fungi, and protozoa that are  
detrimental to gastrointestinal health, and (b) living  
bacteria that are beneficial for gastrointestinal  
health. The invention also relates to another  
composition comprising (a) the immunoglobulin  
20        preparation containing immunologically-active  
immunoglobulins; (b) soluble dietary fiber that provides  
the advantages typically offered by dietary fibers with  
the additional advantages of not affecting blood glucose  
or insulin levels, being readily fermented by the  
25        intestinal microflora and promoting growth of certain  
beneficial intestinal microorganisms; and (c) optionally  
one or more of the following: living intestinal bacteria  
that are beneficial for gastrointestinal health,  
lactoperoxidase and/or thiocyanate for strengthening a  
30        natural non-immune defense system, lactoferrin for  
inhibiting detrimental iron-catalyzed processes and  
harmful microorganisms, and gluconic acid for inhibiting  
growth of harmful bacteria and stimulating immune  
function.

35        Since the time of Hippocrates and throughout the  
Middle Ages, large doses of whey were prescribed by  
alchemists for treating many ailments, primarily acute  
septic conditions. Although it was not then known the  
reason that whey was useful for treating such  
40        conditions, recent studies have shown that whey contains  
antibodies or immunoglobulins capable of providing  
passive immunity against various pathogens and their  
toxic by-products. Antibodies or immunoglobulins are

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5 high molecular weight proteins produced in the bodies of  
mature animals that enhance immunity to infection by  
bacteria, viruses, fungi, protozoa, and the like.  
Antibodies in human and bovine milk promote development  
of a healthy gastrointestinal tract and provide  
10 protection against infections by pathogenic  
microorganisms. These antibodies interfere with the  
process that allows such pathogenic microorganisms to  
adhere to and colonize the intestinal lining. Studies  
have shown that immunoglobulins from whey are  
15 particularly effective against viruses (e.g.,  
rotavirus), bacteria (e.g., *E. coli*, *Vibrio cholerae*,  
*Salmonella*), fungi (e.g., *Candida*), and protozoa (e.g.,  
*Cryptosporidium*).

Detectable levels of anti-rotavirus antibodies  
20 (IgG<sub>1</sub>) have been found in raw and pasteurized milk. R.H.  
Yolken, *Antibody to Human Rotavirus in Cow's Milk*, 312  
New Eng. J. Med. 605 (1985). The high temperatures used  
in processing infant formula, however, destroy all  
traces of naturally occurring IgG<sub>1</sub>. Many infants develop  
25 gastroenteritis around 6 months of age, about the time  
they are weaned from breast milk and started on formula.

Since infants and young children are highly  
susceptible to gastroenteritis, treatment of acute  
diarrhea with concentrated immunoglobulins has been  
30 investigated. In one study, infants hospitalized with  
acute rotavirus gastroenteritis were treated with an  
immunoglobulin concentrate derived from rotavirus-  
immunized cows. H. Hilpert et al., *Use of Bovine Milk  
Concentrate containing Antibody to Rotavirus to Treat  
35 Rotavirus Gastroenteritis in Infants*, 156 J. Infect.  
Dis. 158 (1987). These infants showed significantly  
reduced duration of rotavirus excretion. Thus, bovine  
milk immunoglobulins provided passive immunity against  
rotavirus gastroenteritis in human infants.

40 A bovine milk immunoglobulin concentrate derived  
from *E. coli*-immunized cows has also been shown to

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5       inhibit colonization of enteropathic *E. coli* in affected  
infants. C. Mietens et al., *Treatment of Infantile E. Coli Gastroenteritis with Specific Bovine Anti-E. Coli Milk Immunoglobulins*, Eur. J. Pediatrics (1979). Stool  
10       samples showed a reduction in *E. coli* counts and the  
duration of diarrhea was shortened, demonstrating that  
this concentrate was effective in treating infantile  
diarrhea.

Inflammation of the gastrointestinal mucosa and  
diarrhea associated with Traveler's Diarrhea due to *E.*  
15       *coli* infection have been prevented by treatment with an  
immunoglobulin concentrate from bovine milk. C. Tacket  
et al., *Protection by Milk Immunoglobulin Concentrate against Oral Challenge with Enterotoxigenic Escherichia Coli*, 318 N. Engl. J. Med. 1240 (1988).

20       Immunoglobulins from bovine colostrum have been  
shown to be an effective treatment for diarrhea due to  
a pathogenic protozoan, *Cryptosporidium*. S. Tzipori et  
al., *Remission of Diarrhea Due to Cryptosporidiosis in an Immunodeficient Child Treated with Hyperimmune Bovine Colostrum*, 293 Br. Med. J. 1276 (1986). Immunodeficient  
25       individuals, particularly those with acquired immune  
deficiency syndrome (AIDS), are especially susceptible  
to *Cryptosporidiosis*.

Certain bacteria have also been shown to be  
30       beneficial to human gastrointestinal health. Bacteria  
of the genus *Lactobacillus* have been used for several  
hundred years for treating various illnesses.  
*Lactobacilli* found in the human intestinal tract include  
35       *L. acidophilus*, *L. casei*, *L. fermentum*, *L. salivaro*,  
*L. brevis*, *L. leichmannii*, *L. plantarum*, and *L.*  
*cellobiosus*. In recent years, *L. acidophilus* has been  
shown to be exceptionally useful in treating conditions  
such as antibiotic-induced imbalances in the  
gastrointestinal microflora, hypercholesterolemia,  
40       vaginal infections, *E. coli* infection, oral  
contraceptive failure, depressed immunity, cancerous

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5 tumors, chronic granulomatous disease, and lactose  
indigestion. A.G. Shauss, *Method of Action, Clinical  
Application, and Toxicity Data*, 3 J. Advancement Med.  
163 (1990). *In vitro* studies have shown *L. acidophilus*  
10 bacteria such as *Campylobacter pylori*, *Staphylococcus*  
*aureus*, *Pseudomonas aeruginosa*, and *Sarcina lutea*. K.M.  
Shahani et al., *Natural Antibiotic Activity of*  
*Lactobacillus Acidophilus and Bulgaricus*, 11 *Cultured*  
*Dairy Products J.* 14 (1976).

15 The beneficial effect of *L. acidophilus* is further  
illustrated by preliminary evidence that *L. acidophilus*  
inhibits the toxic activities of bacteria in patients  
with chronic kidney failure. M.L. Simenhoff et al.,  
20 *Biomodulation of Uremic Pathophysiology in Man*, abstract  
presented at Am. Soc. of Nephrology Meeting, Baltimore,  
1992. Such patients often have toxic levels of amines  
in their blood due to bacterial overgrowth in the small  
bowel. Consumption of high levels of freeze dried  
bacteria drastically reduced levels of these toxic  
25 amines. These results demonstrate the ability of *L.*  
*acidophilus* to exert a positive effect on the microflora  
of the intestines.

It has also been shown that the activities of fecal  
bacterial enzymes thought to play a role in conversion  
30 of procarcinogens to carcinogens, such as beta-  
glucuronidase, nitroreductase, and azoreductase, were  
reduced 2- to 4-fold in subjects taking *L. acidophilus*  
supplements. B.R. Goldin & L.S. Gorbach, *The Effect of*  
*Milk and Lactobacillus Feeding on Human Intestinal*  
35 *Bacterial Enzyme Activity*, 39 *Amer. J. Clin. Nutr.* 756  
(1984). These results suggest that dietary  
supplementation with *L. acidophilus* may reduce the risk  
of developing colon cancer.

40 Bifidobacteria are also known to exert a beneficial  
influence on human health. These bacteria exert  
antimicrobial activity in the human intestine by

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5 producing lactic acid and acetic acid as a result of  
carbohydrate metabolism. These acids lower the  
intestinal pH, thereby inhibiting overgrowth of  
gastrointestinal pathogens. Therapeutic applications of  
10 bifidobacteria are indicated for the management of  
diarrhea and constipation, and the management of hepatic  
encephalopathy with hyperammonemia. Additional benefits  
include the production of B vitamins and breakdown of  
carcinogenic N-nitrosamines.

15 *Bifidobacterium adolescentis* is the predominant  
species of bacteria in humans after age two. This  
predominance suggests its exceptional stability and  
prolonged proliferation in the intestine. Nevertheless,  
for any preparation of living microorganisms to function  
20 as a commercial dietary supplement, in addition to being  
able to provide a beneficial effect must also exhibit  
good survival in storage, resistance to inactivation by  
bile, and survival through the gastrointestinal tract.  
Strain-to-strain or isolate-to-isolate variability can  
25 occur as to these traits, thus the selected properties  
should be verified before commercializing any particular  
product containing such microorganisms.

Soluble fiber in the diet is also well known for  
its salutary effects on gastrointestinal health. Such  
effects include providing bulk to the stool, decreasing  
30 the pH of the gastrointestinal tract, producing volatile  
fatty acids, decreasing intestinal transit time, and  
beneficially influencing various blood parameters.  
Dietary fiber has also been shown to have a beneficial  
effect on cholesterol and lipid metabolism that results  
35 in decreased serum cholesterol, triglycerides, and  
phospholipids and an improved (increased) HDL to LDL  
ratio. A study on laboratory animals showed that adding  
fiber to the diet decreases the incidence of bacterial  
translocation, i.e. crossing the intestinal barrier and  
40 entering systemic circulation. C. Palacio et al.,  
*Dietary Fiber: Physiologic Effects and Potential*

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5        *Applications to Enteral Nutrition, in Clinical*  
Nutrition: Enteral and Tube Feeding (2d. ed., 1990).  
Nutritional and epidemiological studies have indicated  
that a general increase in the consumption of dietary  
10        fiber may play a role in preventing deleterious effects  
of oxygen free radicals that have been accused of being  
involved in such processes as aging, inflammation, and  
some disease processes. R. Kohen et al., *Prevention of*  
*Oxidative Damage in the Rat Jejunal Mucosa by Pectin*, 69  
Br. J. Nutrition 789 (1993).

15        While prior art formulas as dietary supplements  
containing soluble dietary fiber or immunoglobulins are  
known and are generally suitable for their limited  
purposes, they possess certain inherent deficiencies  
that detract from their overall utility in restoring and  
20        maintaining gastrointestinal health. For example, a  
dietary supplement containing soluble dietary fiber  
without concentrated immunoglobulins lacks means for  
binding and inactivating foreign antigens such as  
pathogenic bacteria, viruses, fungi, and protozoa that  
25        can infect the gastrointestinal tract and are  
detrimental to the health thereof. Similarly, a dietary  
supplement containing concentrated immunoglobulins  
without soluble dietary fiber lacks means for providing  
bulk to the stool, decreasing the pH of the  
30        gastrointestinal tract, producing volatile fatty acids,  
decreasing intestinal transit time, beneficially  
influencing various blood parameters, beneficially  
influencing cholesterol and lipid metabolism, decreasing  
the incidence of bacterial translocation, preventing  
35        deleterious effects of oxygen free radicals, and  
favoring the growth of beneficial bacteria in the  
gastrointestinal tract. Further, such prior art  
formulas fail to provide living intestinal bacteria that  
are beneficial for gastrointestinal health by providing  
40        an inhibitory effect on the growth of pathogenic  
bacteria, reducing levels of toxic amines, and lowering



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5 the pH of the gastrointestinal tract. Further, prior art dietary supplements fail to provide components, such as lactoperoxidase and thiocyanate, that strengthen the body's natural non-immune defense system or LP-system. Moreover, these formulas do not contain inhibitors of detrimental iron-catalyzed processes and stimulators of immune function.

10 In view of the foregoing, it will be appreciated that a composition for improving gastrointestinal health comprising living bacteria that exert a beneficial effect on the gastrointestinal tract and an immunoglobulin preparation containing immunoglobulins that bind and inactivate pathogenic microorganisms in the gastrointestinal tract would be a significant advancement in the art. It will also be appreciated that a composition for improving and maintaining gastrointestinal health comprising an immunoglobulin preparation containing immunoglobulins that bind and inactivate pathogenic microorganisms in the gastrointestinal tract and soluble dietary fiber that provides the typical advantages of dietary fiber and additionally is low in calories, does not affect blood glucose or insulin levels, and favors the growth of beneficial bacteria in the gastrointestinal tract while at the same time inhibiting the growth of potentially pathogenic or harmful microorganisms would be another significant advancement in the art.

#### Objects and Summary of the Invention

35 It is an object of the present invention to provide a composition for use as a dietary supplement that benefits human gastrointestinal health when administered orally.

40 It is also an object of the invention to provide a composition for use as a dietary supplement that, when ingested, is effective for treating ailments due to

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5       gastrointestinal pathogens such as bacteria, viruses, fungi, or protozoa.

          It is another object of the invention to provide a composition for use as a dietary supplement that, when ingested, results in decreased serum cholesterol, triglycerides, and phospholipids and an increased HDL to LDL ratio.

10       It is still another object of the invention to provide a composition for use as a dietary supplement that aids in preventing deleterious effects of oxygen free radicals.

15       It is yet another object of the invention to provide a composition for use as a dietary supplement that bolsters the body's immune system and the natural non-immune system, the LP system.

20       It is a further object of the invention to provide a composition for use as a dietary supplement that inhibits detrimental iron-catalyzed processes in the body.

          These and other objects can be accomplished by providing a composition for use as a dietary supplement for promoting gastrointestinal health comprising an effective amount of a beneficial human intestinal microorganism and an effective amount of an immunoglobulin composition comprising concentrated immunologically active immunoglobulins. Such immunoglobulins can be obtained from any viable source, but are preferably obtained from bovine milk or a milk product. Most preferably, such immunoglobulins are purified from whey. The beneficial human intestinal microorganism is selected from the group consisting of lactobacilli and bifidobacteria. *Lactobacillus acidophilus* and *Bifidobacterium adolescentis* are preferred, and *L. acidophilus* strain NCFM is more preferred. The immunoglobulin composition can further comprise an inert carrier, such as a carbohydrate and/or a lipid.

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5           A method of promoting gastrointestinal health  
comprises the step of orally administering an effective  
amount of the bacteria and immunoglobulin-containing  
composition described above. This method is also  
10       effective against bacteria, viruses, fungi, and protozoa  
that cause diarrhea, constipation, and other forms of  
gastrointestinal distress.

          An immunoglobulin and fiber-containing composition  
for use as a dietary supplement for restoring and  
maintaining gastrointestinal health comprises in percent  
15       by weight

          (a) about 40 to about 60% of an immunoglobulin  
composition comprising concentrated immunologically  
active immunoglobulins; and

          (b) about 40 to about 60% of soluble dietary  
20       fiber, wherein the fiber is a member selected from the  
group consisting of inulin, fructo-oligosaccharides,  
pectin, guar gum, and mixtures thereof. The  
immunoglobulin and fiber-containing composition can  
optionally contain about 0 to about 20% by weight of a  
25       beneficial human intestinal microorganism selected from  
the group consisting of lactobacilli and bifidobacteria.  
Preferably, the beneficial human intestinal  
microorganism is present in an amount in the range of  
about 0.1 to about 20% by weight, and more preferably of  
30       about 5 to about 10% by weight. The immunoglobulin and  
fiber-containing composition can also optionally contain  
one or more of the following ingredients:

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Ingredient	Ranges in Percent by Weight	
	Broad	Preferred
Lactoperoxidase	0-0.0300%	0.0001-0.0300%
Thiocyanate salt	0-0.0500%	0.0001-0.0500%
Lactoferrin	0-0.1000%	0.0001-0.1000%
Gluconic acid	0-10%	0.1-10%

The beneficial human intestinal microorganism is preferably selected from the group consisting of *Lactobacillus acidophilus*, *L. bulgaricus*, *L. casei*, *L. fermentum*, *L. salivarius*, *L. brevis*, *L. leichmannii*, *L. plantarum*, *L. cellobiosus*, *Bifidobacterium adolescentis*, *B. infantis*, *B. longum*, *B. thermophilum*, and *B. bifidum*. More preferably, the beneficial human intestinal microorganism is selected from *L. acidophilus* and *B. adolescentis*. A preferred strain of *L. acidophilus* is strain NCFM.

The immunoglobulin composition can also include a carrier. A preferred carrier comprises at least one member selected from the group consisting of a carbohydrate and a lipid, wherein the carbohydrate is capable of being an energy source for a beneficial human intestinal microorganism and the lipid aids in reconstitution of the immunoglobulin composition. A preferred carbohydrate is maltodextrin, and a preferred lipid is lecithin. Preferably, the immunoglobulin composition is purified from a source selected from the group consisting of milk, milk products, and whey, with a bovine source also being preferred.

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5           A method of restoring and maintaining  
gastrointestinal health comprises the step of orally  
administering an effective amount of an immunoglobulin  
and fiber-containing composition for promoting  
gastrointestinal health comprising in percent by weight  
10           (a) about 40 to about 60% of an immunoglobulin  
composition comprising concentrated immunologically  
active immunoglobulins; and  
             (b) about 40 to about 60% of soluble dietary  
fiber, wherein the fiber is a member selected from the  
15           group consisting of inulin, fructo-oligosaccharides,  
pectin, guar gum, and mixtures thereof.

#### Brief Description of the Drawings

20           FIG. 1 shows growth curves for *Candida* (●) cultured  
alone, and for a mixed culture of *Candida* (◆) and *L.*  
*acidophilus* NCFM (▲).

25           FIG. 2 shows growth curves for *Candida* (●) cultured  
alone, and for a mixed culture of *Candida* (◆) and *L.*  
*acidophilus* NCFM (▲) also containing an immunoglobulin  
composition according to the present invention.

             FIG. 3 shows growth curves for *Candida* (●) cultured  
alone, and for *Candida* (◆) cultured in the presence of  
an equal amount of immunoglobulin composition as in FIG.  
2.

30           FIG. 4 shows growth curves for *S. typhimurium* (●)  
cultured alone, and for a mixed culture of *S.*  
*typhimurium* (◆) and *L. acidophilus* NCFM (▲).

35           FIG. 5 shows growth curves for *S. typhimurium* (●)  
cultured alone, and for a mixed culture of *S.*  
*typhimurium* (◆) and *L. acidophilus* NCFM (▲) also  
containing an immunoglobulin composition according to  
the present invention.

#### Detailed Description of the Invention

40           Before the present composition and methods of use  
are disclosed and described, it is to be understood that

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5       this invention is not limited to the particular  
examples, process steps, and materials disclosed herein  
as such process steps and materials may vary somewhat.  
It is also to be understood that the terminology  
employed herein is used for the purpose of describing  
10       particular embodiments only and is not intended to be  
limiting since the scope of the present invention will  
be limited only by the appended claims and equivalents  
thereof.

It must be noted that, as used in this  
15       specification and the appended claims, the singular  
forms "a," "an," and "the" include plural referents  
unless the context clearly dictates otherwise. Thus,  
for example, reference to a composition containing "a  
microorganism" includes a mixture of two or more  
20       microorganisms, reference to "an immunoglobulin"  
includes reference to two or more of such  
immunoglobulins, and reference to "a concentrate"  
includes reference to a mixture of two or more of such  
concentrates.

25       In describing and claiming the present invention,  
the following terminology will be used in accordance  
with the definitions set out below.

As used herein, "immunoglobulin composition" means  
a composition comprising an effective amount of  
immunologically active immunoglobulins. Preferably,  
30       these are present as concentrated immunologically active  
immunoglobulins. One such immunoglobulin composition is  
sold under the trademark "PROBIOPLEX" by Metagenics,  
Inc. (San Clemente, California). PROBIOPLEX contains  
35       (1) about 55-60 parts by weight of an immunoglobulin  
concentrate from bovine whey wherein at least about 7%  
by weight of the total solids in the concentrate is  
immunologically active immunoglobulins, (2) about 35-40  
parts by weight of a mixture of carbohydrates including  
40       rice maltodextrin and lactose, and (3) about 5-10 parts  
by weight of lipid including lecithin. Thus, at least

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5       about 3.6% by weight of the total PROBIOPLEX composition  
comprises immunologically active immunoglobulins. The  
carbohydrates and lipids function as inert carriers for  
the immunoglobulins. The rice maltodextrin can function  
10       further as an energy source for beneficial  
microorganisms with which the immunoglobulin composition  
can be mixed in accordance with the present invention.  
The lecithin aids in dispersion of the powder form of  
the immunoglobulin composition when reconstituted with  
15       water or other liquid. Although PROBIOPLEX contains  
ingredients other than concentrated immunologically  
active immunoglobulins, these other ingredients are  
optional components of the invention. What is required  
is that the immunoglobulin composition contain an  
20       "effective amount" of immunologically active  
immunoglobulins that are preferably present in  
concentrated form.

As used herein, "beneficial human intestinal  
microorganism" means an organism of microscopic size,  
such as a bacterium, that inhabits the human intestine  
25       and exerts a beneficial effect on the gastrointestinal  
health of an individual in which it resides. Preferred  
beneficial human intestinal microorganisms according to  
the present invention include bacteria of the genera  
*Lactobacillus* and *Bifidobacterium*. A more preferred  
30       lactobacillus is *L. acidophilus*, with *L. acidophilus*  
strain NCFM being most preferred, and a more preferred  
bifidobacterium is *B. adolescentis*. Other lactobacilli  
that are beneficial to gastrointestinal health include  
*L. bulgaricus*, *L. casei*, *L. fermentum*, *L. salivaro*, *L.*  
35       *brevis*, *L. leichmannii*, *L. plantarum*, and *L.*  
*cellobiosus*. Other bifidobacteria that are beneficial  
to gastrointestinal health include *B. infantis*, *B.*  
*longum*, *B. thermophilum*, and *B. bifidum*.

As used herein, "effective amount" means an amount  
40       necessary to achieve a selected result. For example, an  
effective amount of an immunoglobulin and bacteria-

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5 containing composition useful for reducing the titer of  
a selected pathogenic microorganism in the  
gastrointestinal tract would be an amount that achieves  
the selected result of reducing the titer of the  
microorganism. Such an amount can be readily determined  
10 without undue experimentation by a person of ordinary  
skill in the art. As another example, an effective  
amount of an immunoglobulin and fiber-containing  
composition useful for reducing the titer of a selected  
pathogenic microorganism in the gastrointestinal tract  
15 would be an amount that achieves the selected result of  
reducing the titer of the microorganism. Such an amount  
can also be readily determined without undue  
experimentation by a person of ordinary skill in the  
art.

20 As used herein, "thiocyanate salt" means a  
nutritionally acceptable salt of the thiocyanate anion,  
such as sodium thiocyanate, potassium thiocyanate,  
ammonium thiocyanate, and mixtures thereof.

As reviewed above, immunoglobulin concentrates from  
25 milk contain immunologically active immunoglobulins that  
are capable of binding pathogenic microorganisms such as  
bacteria, viruses, fungi, and protozoa. Such  
immunoglobulin concentrates can be prepared from any  
starting material containing sufficient concentrations  
30 of immunologically active immunoglobulins, such as  
milk, whey, blood, and the like. An economically viable  
source of such immunoglobulins is the whey byproduct of  
the cheese making process. It has been estimated that  
approximately 85 million metric tons of whey are created  
35 annually as a byproduct of cheese production worldwide.  
About 34 million metric tons of whey are not  
economically utilized, and thus are discarded. The whey  
byproduct of cheese making, therefore, presents an  
inexpensive and ready source of immunoglobulins.

40 Numerous techniques are known to exist for  
producing dry concentrated protein extract from whey.



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5        This protein extract is commonly referred to as whey  
protein concentrate or "WPC." Such protein extraction  
and concentration techniques have been primarily  
concerned with preserving the food qualities of the WPC,  
such as taste, flavor, and solubility. Although these  
10       techniques are useful for producing food products, they  
almost universally destroy or substantially reduce the  
immunological activity of immunoglobulins in the  
concentrate by exposing the raw milk, whey, or protein  
concentrate to (1) excessive thermal (time and  
15       temperature) conditions, (2) excessive bacterial  
activity, or (3) excessive enzymes added in processing  
or resulting from bacterial activity.

Methods have been developed for separating  
immunologically active immunoglobulins from raw milk.  
20       U.S. Patent Nos. 4,816,252 and 4,834,974 describe such  
methods, which are illustrative of methods that can be  
used for preparing an immunologically active  
immunoglobulin concentrate according to the present  
invention. Raw milk is first flash pasteurized to  
25       control microbial activity in the milk without  
significantly diminishing the immunological activity of  
the immunoglobulins in the milk. Next, the milk is  
exposed to an appropriate cheese starter culture, such  
as a lactobacillus, at carefully controlled temperatures  
30       and for limited times to achieve a selected degree of  
curd formation without significantly affecting the  
immunological activity of the immunoglobulins. The whey  
is then separated from the cheese curd and transferred  
to a clarifier or separator under carefully controlled  
35       conditions to remove fat and casein particles. The  
clarified whey is then subjected to ultrafiltration to  
remove or substantially reduce the amounts of small  
proteins, salts, and other non-protein materials in the  
retained protein concentrate or retentate.  
40       Ultrafiltration can be performed in stages to optimize  
purification of the immunoglobulins. Optionally, other

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5 concentration and purification steps, such as reverse  
osmosis and ion exchange chromatography, can then be  
used to further improve the purity and concentration of  
the immunoglobulin concentrate while maintaining the  
immunological activity thereof. The immunoglobulin  
10 concentrate is then dried through conventional freeze-  
drying or spray drying methods. The resulting dry  
immunoglobulin concentrate can then be stored at room  
temperature. At least about 7% of the total solids of  
immunoglobulin concentrates prepared by these methods  
15 comprise immunologically active immunoglobulins. When  
ultrafiltration and ion exchange chromatography are both  
used in the purification procedure, the proportion of  
immunologically active immunoglobulins as a percentage  
of total solids can be increased to at least about 50%.  
20 Repeated ion exchange chromatography steps can further  
increase the proportion of immunologically active  
immunoglobulins as a percentage of total solids. U.S.  
Patent Nos. 4,816,252 and 4,834,974 are hereby  
incorporated herein by reference as illustrative of  
25 methods for purifying immunologically active  
immunoglobulin concentrate. The present invention is  
not limited to these methods, however, and any method of  
purifying and concentrating immunologically active  
immunoglobulins from milk, whey, or another suitable  
30 source is to be considered within the scope of the  
invention as long as an effective amount of  
immunologically active immunoglobulins is obtained in  
the "immunoglobulin composition." Bovine milk and  
bovine whey are preferred sources of immunoglobulins,  
35 but other species of animal could also be used.

Certain bacteria have also been shown to be  
beneficial to human gastrointestinal health, as briefly  
reviewed above. The intestinal flora of the human gut  
contains some  $100 \times 10^9$  viable bacteria, representing 100  
40 or more different species. The major bacteria can be  
roughly divided into three groups: (a) lactic acid

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5 bacteria, including lactobacilli, bifidobacteria, and streptococci; (b) anaerobic bacteria; and (c) aerobic bacteria.

10 Bacteria of the genus *Lactobacillus* have been used for several hundred years for treating various illnesses. Bifidobacteria are also known to exert a beneficial influence on human health. Bifidobacteria constitute the predominant microorganisms in the fecal flora of week-old breast-fed infants, making up 85-99% of the bacterial population. Upon weaning or upon the  
15 occurrence of perturbations such as an infection, vaccination, a sudden change in diet, and even the weather the balance of microorganisms in the gastrointestinal tract of these babies can be upset. Bifidobacteria can also be significantly reduced in  
20 elderly people due to a reduction of secreted gastric juices. The bifidobacterial population in adults is much more stable, however changes in diet, administration of antibiotics, exposure to gamma radiation or X-rays, disease, stress, and other  
25 disturbances can result in overgrowth of potentially pathogenic bacteria, decrease in beneficial bacteria (lactobacilli and bifidobacteria), and a resulting imbalance in the gastrointestinal flora. Hyperproliferation of harmful bacteria in the gut is  
30 associated with various forms of diarrhea, susceptibility to systemic infections, constipation, vague and acute abdominal symptoms, fatigue, dyspepsia, and presence of carcinogenic metabolites. Reestablishment of a normal balance of gastrointestinal  
35 flora can be accelerated, and such normal balance maintained, with dietary administration of lactobacilli and/or bifidobacteria.

Lactobacilli and bifidobacteria produce organic acids that reduce intestinal pH and thereby inhibit the  
40 growth of acid-sensitive undesirable bacteria. Lactobacilli produce lactic acid, hydrogen peroxide, and

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5 possibly acetic and benzoic acids. Bifidobacteria  
produce short chain fatty acids (SCFA) such as acetic,  
propionic, and butyric acids, as well as lactic and  
formic acids. The most plentiful short chain fatty acid  
10 produced by bifidobacteria is acetic acid, which has a  
wide range of antimicrobial activities against yeasts,  
molds, and other bacteria. Additionally, short chain  
fatty acids support normal gastrointestinal function by  
increasing colonic blood flow, stimulating pancreatic  
15 enzyme secretion, promoting sodium and water absorption,  
and potentiating intestinal mucosal growth.  
Bifidobacteria are also known to deconjugate bile salts  
to free bile acids, which are more inhibitory to  
susceptible bacteria than are the conjugated forms.  
Further, lactobacilli and bifidobacteria are able to  
20 produce other antimicrobial substances, such as  
bacteriocins, that inhibit the growth and proliferation  
of harmful bacteria in the gut.

The advantages of soluble dietary fiber have also  
been briefly reviewed above. Inulin is one such fiber  
25 that is composed of a mixture of oligomers and polymers  
of fructose. Inulin is a storage carbohydrate found in  
many plants including onion, asparagus, artichoke, and  
many cereals. Chicory root and Jerusalem artichoke each  
contain about 70% by weight of inulin. Inulin has been  
30 an important food in Europe for many years and is  
currently being used as a source of dietary fiber, for  
replacing fat in the diet, and for promoting growth of  
beneficial bacteria in the intestine. In the U.S.,  
inulin is added to all types of noodles. It has a  
35 moderately sweet taste, is highly soluble, and is a  
frequent replacement for sugar in many foods.  
Medically, inulin is the substance of choice to study  
renal clearance and impaired kidney function.

Fructo-oligosaccharides (FOS) are another type of  
40 soluble dietary fiber. FOS is widely distributed in  
nature and is found in honey, beer, onion, asparagus,

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5 Chinese chive, banana, maple sugar, oats, and Jerusalem artichoke.

Upon ingestion, both inulin and FOS are hydrolyzed to a negligible extent as they pass through the mouth, stomach, and small intestine. In the large intestine, they are readily fermented by the intestinal microflora. These carbohydrates are metabolized by the bacteria into short chain fatty acids, mainly acetic, propionic, butyric, and lactic acids. As a consequence of this fermentation, a considerable amount of bacterial mass is produced, which increases stool wet weight. The short chain fatty acids are absorbed by the large intestine and are further metabolized in the liver. This allows the body to recover some energy from inulin and FOS, although the efficiency of energy conversion is markedly lower than with other carbohydrates. This phenomenon underlies the low calorie content of fructans and dietary fibers.

Inulin and FOS are used as a source of energy in the intestinal tract mainly by bacteria in the genus *Bifidobacterium*. H. Hidaka et al., *Effects of Fructooligosaccharides on Intestinal Flora and Human Health*, 5 *Bifidobacteria Microflora* 37-50 (1986). When inulin and FOS are administered in the diet, the bifidobacteria increase significantly, becoming the predominant bacteria in the intestinal population, and the clostridia, which are a measure of potentially pathogenic microorganisms, are significantly reduced. As will be discussed in more detail below, bifidobacteria are human intestinal bacteria that provide beneficial effects on gastrointestinal health. Other important groups of bacteria in the mixed population in the intestines, such as *Fusobacterium*, *Lactobacillus*, and aerobic bacteria, are not significantly affected by the administration of inulin and FOS. H. Hidaka et al., *Effects of*

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5      *Fructooligosaccharides on Intestinal Flora and Human Health*, 5 Bifidobacteria Microflora 37-50 (1986).

10      It has been shown, A. Hata, *The Influence of Neosugar on the Lipid Metabolism of Experimental Animals*, Proc. 1st Neosugar Res. Conference, Tokyo (1982), that fructo-oligosaccharides (FOS) in the diet of experimental animals cause reduction of blood sugar, serum cholesterol, triglycerides, and phospholipids; significant improvement in the HDL/LDL ratio; an increase in free fatty acids; and significant decreases  
15      in total cholesterol in lipedemia cases.

20      It has also been shown, H. Hadaka et al., *Effects of Fructooligosaccharides on Intestinal Flora and Human Health*, 5 Bifidobacteria Microflora 37-50 (1986), that administration of fructo-oligosaccharides (FOS) enhances growth of the bifidobacteria population in the intestine, suppresses production of putrefactive factors, improves blood lipid levels in hyperlipidemia patients, and provides relief from constipation.

25      Therefore, at least the following positive effects are obtained by addition of inulin and/or fructo-oligosaccharides (FOS) to a composition for use as a dietary supplement according to the present invention: reduction of intestinal disorders, enhancement of a balanced intestinal microflora, and remediation of  
30      constipation.

35      Other preferred dietary fibers according to the present invention include pectin and guar gum. Pectin is a highly water soluble, noncellulosic polysaccharide fiber extracted from the primary cell walls of plants. Rich sources of pectin include lemon and orange rinds, which contain about 30% by weight of this polysaccharide. Pectin occurs naturally as a partial methyl ester of  $\alpha$ -(1 $\rightarrow$ 4) linked D-polygalacturonate sequences interrupted with (1 $\rightarrow$ 2)-L-rhamnose residues.  
40      Pectins are used as gelling and thickening agents in food technology and as an antidiarrheal in veterinary

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5        medicine. Guar gum is produced from the ground  
endosperms of *Cyamopsis tetragonolobus*, a legume  
cultivated in India as a livestock feed. The water  
soluble fraction, which comprises about 85% of guar gum  
and is known as guaran, consists of linear chains of  
10        (1→4)-β-D-mannopyranosyl units with α-D-galactopyranosyl  
units attached by (1→6) linkages. The ratio of D-  
galactose to D-mannose is 1:2. Guar gum has 5 to 8  
times the thickening power of starch and, thus, is used  
as a thickener in foods, as a binder and disintegrating  
15        agent in tablet formulations, and in pharmaceuticals and  
cosmetics.

Pectin and guar gum have several beneficial effects  
on the gastrointestinal tract, such as maintaining the  
morphology of intestinal villi, increasing lipase  
20        activity in the small bowel, delaying gastric emptying  
time, increasing intestinal transit time, and promoting  
increased fecal production of short chain fatty acids.  
It is believed that pectin and guar gum in the diet  
lower blood glucose and serum cholesterol levels, B.  
25        Flourie et al., *The Effect of Pectin on Jejunal Glucose  
Absorption and Unstirred Layer Thickness in Normal Man*,  
25 Gut 1936 (1984). Also, dietary fiber supplementation  
with pectin or guar gum has also been found to  
significantly suppress the incidence of colon cancer.  
30        G. Arbman, *Cereal Fiber, Calcium and Colorectal Cancer*,  
69 Cancer 2042 (1992). Studies with whole apples show  
that fiber (pectin) in the fruit reduces the insulin  
response to the sugar in the fruit and prevents  
"rebound" hypoglycemia. D. Jenkins et al., *Dietary*  
35        *Fiber, Fiber Analogues and Glucose Tolerance, Importance  
of Viscosity*, 1 Br. Med. J. 1392 (1978). Further,  
pectin and guar gum are readily degraded by bacterial  
fermentation in the colon, probably because of their  
high water solubility.

40        Moreover, pectin and guar gum are also thought to  
prevent oxidative damage in the gastrointestinal tract.

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5       Oxygen free radicals are involved in many deleterious  
processes including aging, inflammation, and some  
disease processes. The gastrointestinal mucosa is  
exposed to oxidants produced within the lumen and in the  
epithelial cells. Potential sources of luminal oxidants  
10       include ingested food, catalase-negative bacteria, and  
cigarette smoke and other pollutants. The production of  
reactive free radicals during metabolism of dietary fat  
can explain some the biological damage such as loss of  
membrane function, inactivation of membrane-bound  
15       enzymes, and inactivation of essential molecules located  
inside the cell. Other tests have shown that a large  
amount of fat in the diet can be a presumptive  
carcinogen. H. Hidaka et al., *Effects of*  
*Fructooligosaccharides on Intestinal Flora and Human*  
20       *Health*, 5 Bifidobacteria Microflora 37-50 (1986). Apart  
from these carcinogenic changes, still other injuries  
associated with free radicals include ulcerative  
diseases, inflammation, and ischemic bowel disease.  
Pectin and guar gum prevent oxidative damage in various  
25       ways. They directly scavenge intestinal oxidants.  
Further, pectin can act as a chelating agent of loosely  
bound transition metals in the lumen. Moreover, pectin  
also reacts directly to prevent spontaneous dismutation  
of superoxide radicals and thus prevents the formation  
30       of hydrogen peroxide.

In human and animal tissues, peroxidases form part  
of a natural non-immune defense system and also play a  
role in protecting against microbial invasion of mucous  
membranes. Peroxidases occur in various exocrine gland  
35       secretions including salivary, lachrymal, bronchial,  
nasal, and intestinal secretions and in milk. Milk  
peroxidases, known as lactoperoxidases (LP) are the  
predominant enzymes in bovine milk. LP has no intrinsic  
antibacterial activity, however, together with hydrogen  
40       peroxide and thiocyanate anion it forms a potent natural  
antibacterial system, the so-called lactoperoxidase or



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5 LP system (for review see B. Reiter, *Bacterial Inhibitors in Milk and Other Secretions with Special Reference to the Complement, Transferrin and Lactoperoxidase/Thiocyanate/Hydrogen Peroxide Systems*, in *Inhibition and Inactivation of Vegetative Microbes* 31-60 (1976); B. Reiter & J.-P. Perraudin, *Lactoperoxidase: Biological Functions*, in *Peroxidases in Chemistry and Biology* 143-180 (1991). The antibacterial effect of the LP system is mediated by the generation of short-lived oxidation products of thiocyanate anion (SCN), mainly the hypothiocyanate ion (OSCN). LP is a highly active enzyme, and very low concentrations are sufficient to establish an effective system. A wide range of bacterial species is affected by the LP system. Gram-negative bacteria generally are killed or their growth inhibited. Gram-positive bacteria usually are more resistant, however, and in general only their growth is inhibited. The LP system can also affect certain viruses, yeasts, and molds.

25 The thiocyanate anion is widely distributed in animal and human tissues, body-fluids, and secretions. It is found in the mammary, salivary, and thyroid glands, in the stomach and kidneys, in synovial, cerebral, and spinal fluid, and in lymph and plasma. The major dietary sources of thiocyanate ion are vegetables such as cabbage, cauliflower, and turnip, which are rich in glucosinolates that yield thiocyanate ion upon hydrolysis.

35 The activity of the LP system arises from an LP-catalyzed reaction in which hydrogen peroxide oxidizes thiocyanate ion (SCN) to form the hypothiocyanate ion (OSCN). The hypothiocyanate ion then oxidizes sulfhydryl groups in vital metabolic enzymes and other proteins of the microorganisms. The mechanisms of antimicrobial activity of the LP system result in damage to bacterial membranes and inhibition of essential transport mechanisms, such as those involving glucose

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5 and amino acids, and inhibition of synthesis of nucleic acids and proteins, including vital metabolic enzymes such as those involved in glycolysis.

Microorganisms inhibited by the LP system include a number of Gram-positive bacteria, including species of  
10 *Staphylococcus* and *Streptococcus*, and some Gram-negative species, e.g., *E. coli*, *Salmonella*, *Pseudomonas*. Some lactic acid bacteria, e.g. lactobacilli and bifidobacteria, are unaffected by the LP system because they contain a "reversal enzyme" called NAD(P)-OSCN-  
15 oxidase reductase, which prevents the antimicrobial activity of the LP system.

Lactoperoxidase is a highly active enzyme, and very low concentrations, along with low concentrations of hydrogen peroxide and thiocyanate ion, are sufficient to  
20 obtain an effective system. Hydrogen peroxide is known to be produced in many species of lactobacilli, and thiocyanate ion is widely distributed in animal and human tissues, body fluids, and secretions.

Advantages of the LP system include a greater  
25 antimicrobial efficacy and a wider spectrum of activity than existing preservatives. Also, the active antimicrobial agents of the LP system (OSCN and HOSCN) disappear from food after processing, thus providing a safe, long-lasting food preservative without the  
30 presence of the active preservative agents. Further, the LP system acts in synergy with other preservatives, thus increasing the efficacy of such other preservatives. Moreover, the LP system has a very low level of toxicity.

35 Lactoferrin is an iron-binding protein present in milk. For example, bovine milk contains about 200 mg/l of lactoferrin, and human milk and colostrum contain about 2-4 g/l and 6-8 g/l of lactoferrin, respectively. The affinity of lactoferrin for iron is very high, e.g.  
40 about 300 times that of the iron-transporting protein, transferrin, in blood plasma. A lactoferrin molecule

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5 binds one ferric ion ( $\text{Fe}^{3+}$ ) by means of a bicarbonate-dependent reaction.

10 The high affinity for iron enables the use of lactoferrin for inhibiting iron-catalyzed processes, such as generation of free hydroxyl radicals, lipid peroxidation, and growth of microorganisms. Most microorganisms need iron for growth. Lactoferrin is able to inhibit the growth of such microorganisms by depriving them of iron. Lactoferrin is bacteriostatic to a wide range of microorganisms, including Gram-  
15 negative bacteria with a high iron requirement and some Gram-positive bacteria. Lactic acid bacteria, such as lactobacilli and bifidobacteria, have a low iron requirement and, in general, are not affected by lactoferrin. Although lactoferrin is primarily  
20 bacteriostatic, heat-treated lactoferrin is bactericidal. Heat-treated lactoferrin is easily obtained by heating lactoferrin at acidic pH.

Lactoferrin has been demonstrated in *in vitro* and *in vivo* tests to be effective against a variety of  
25 microorganisms, including *E. coli*, *Staphylococcus epidermidis*, *Streptococcus pneumoniae*, and *Candida albicans*, while at the same time promoting the growth of bifidobacteria. Lactoferrin retains iron at low pH and can pass through the acid environment of the stomach and  
30 enter the intestine unaltered.

As described above, various indigestible saccharides, such as FOS, have been developed for promoting the growth of bifidobacteria. Another substance that promotes the growth of bifidobacteria is  
35 gluconic acid and its salts (gluconates). It has been shown in *in vitro* fermentation tests that gluconate is utilized selectively by bifidobacteria as an energy source. H. Sato et al., *Antioxidant Activity of Synovial Fluid, Hyaluronic Acid, and Two Subcomponents of Hyaluronic Acid*, 31 *Arthritis & Rheumatism* (1988).  
40 In addition to promoting the growth of bifidobacteria,

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5 gluconic acid, like other organic acids, also suppresses  
the growth of certain harmful bacteria, such as  
*Clostridium perfringens*. Test results have further  
shown that ingested gluconic acid and gluconates are not  
10 absorbed in the small intestine, but instead are able to  
reach the large intestine where they can be utilized as  
an energy source by bifidobacteria. Sato et al.,  
*Antioxidant Activity of Synovial Fluid, Hyaluronic Acid,*  
*and Two Subcomponents of Hyaluronic Acid*, 31 *Arthritis*  
& *Rheumatism* (1988).

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Bacteria and Immunoglobulin-Containing Composition

A bacteria and immunoglobulin-containing  
composition according to the present invention comprises  
a mixture of an immunoglobulin composition and a  
20 beneficial human intestinal bacterium, such as a  
lactobacillus or a bifidobacterium or mixtures thereof.  
The composition is made by mixing dry immunologically  
active immunoglobulins with dry beneficial human  
intestinal bacteria. The bacteria are prepared, for  
25 example, by culturing in a rich medium such as LB, J.  
Miller, *Experiments in Molecular Genetics*, Cold Spring  
Harbor Laboratory, Cold Spring Harbor, N.Y. (1972),  
until the late log phase of growth is reached. The  
bacteria are then concentrated and lyophilized according  
30 to standard methods. The dry immunoglobulins and dry  
bacteria are then mixed in selected proportions. Just  
prior to consumption, the dry composition is  
reconstituted with water, juice, or the like to result  
in a smooth liquid composition that can be consumed  
35 orally.

It has been found that oral administration of such  
a bacteria and immunoglobulin-containing composition has  
a beneficial effect on gastrointestinal health.  
Although immunoglobulin compositions containing  
40 immunologically active immunoglobulins and beneficial  
bacteria such as lactobacilli and bifidobacteria each

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5 have some effect on diminishing the growth of pathogenic  
microorganisms in the gastrointestinal tract, it has  
been surprising to discover that a composition  
containing a mixture of the immunoglobulin composition  
and beneficial bacteria has a synergistic effect in  
10 causing death of the pathogenic microorganisms and in  
restoring gastrointestinal health. Regular consumption  
of the bacteria and immunoglobulin-containing  
composition has the effect of maintaining good  
gastrointestinal health. The bacteria and  
15 immunoglobulin-containing composition contains an  
effective amount of each of the bacterial and  
immunoglobulin components, and preferably contains  
weight ratios of bacteria to immunologically active  
immunoglobulins in the range of about 20:1 to about  
20 1:20. More preferably, the weight ratios of bacteria to  
immunologically active immunoglobulins are in the range  
of about 1:5 to about 10:1.

The effects of exposing pathogenic microorganisms  
to bacteria and immunoglobulin-containing compositions  
25 according to the present invention are illustrated in  
the following examples. These examples are merely  
illustrative and are not intended to delimit the scope  
of the invention.

#### 30 EXAMPLE 1

*In vitro* cultures of *Candida albicans* were prepared  
by subculturing from a stock culture in a rich liquid  
medium. Cultures were incubated at 37°C, and cells were  
counted by dilution and plating on plate count agar.  
35 FIG. 1 shows cell viability in cultures containing *C.*  
*albicans* alone (●) and cultures containing both *C.*  
*albicans* (◆) plus *L. acidophilus* strain NCFM (▲).  
During the course of this study, the *C. albicans*  
multiplied at the same rate regardless of the presence  
40 or absence of the *L. acidophilus* NCFM. The number of  
viable *L. acidophilus* NCFM cells, however, was

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5       diminished by a factor of about 20 in the presence of *C. albicans* cells.

## EXAMPLE 2

10       FIG. 2 shows the cell viability in cultures containing *C. albicans* alone (●) and cultures containing both *C. albicans* (◆) and *L. acidophilus* strain NCFM (▲) as in Example 1, with the exception that the immunoglobulin composition containing immunologically active immunoglobulins was added to the mixed cultures of *C. albicans* plus *L. acidophilus* strain NCFM in a weight ratio of 1 part of *L. acidophilus* strain NCFM to 5 parts of immunoglobulin composition. Two predominant differences occurred in this example compared to Example 1. First, the viability of *L. acidophilus* strain NCFM was enhanced by a factor of about 4 to 5 in the presence of the immunoglobulin composition as compared to cultures in which the immunoglobulin composition was absent. Second, the viability of *C. albicans* was greatly reduced after about 20 hours of co-culturing with *L. acidophilus* strain NCFM in the presence of the immunoglobulin composition. In other experiments, it has been found that the immunoglobulin composition by itself did not affect the viability of *C. albicans* (FIG. 3). Thus, although neither *L. acidophilus* strain NCFM nor the immunoglobulin composition alone affected the growth and viability of *C. albicans* in vitro, the mixture of *L. acidophilus* strain NCFM and the immunoglobulin composition caused a rapid decline in the viability of *C. albicans*. Further, the growth and viability of *L. acidophilus* strain NCFM was enhanced in co-culture with *C. albicans* in the presence of the immunoglobulin composition as compared to when the immunoglobulin composition was absent. These results were unforeseen, i.e. that the combination of beneficial bacteria and immunoglobulins would yield a better result than the additive effects of the bacteria and the

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5 immunoglobulins, and that the immunoglobulins would  
improve the viability of the bacteria in co-culture with  
another microorganism. Further, these results were  
considered predictive of what would occur in vivo since  
lactobacilli are known to survive in the  
10 gastrointestinal tract and immunoglobulins have been  
shown to provide passive immunity to certain pathogens  
upon oral administration.

## EXAMPLE 3

15 In vitro cultures of *Salmonella typhimurium* were  
prepared by subculturing from a stock culture in a rich  
liquid medium, J. Miller, Experiments in Molecular  
Genetics, Cold Spring Harbor Laboratory, Cold Spring  
Harbor, N.Y. (1972). Cultures were incubated at 37°C,  
20 and cells were counted by dilution and plating on plate  
count agar.

FIG. 4 shows growth curves for cultures containing  
*S. typhimurium* alone and cultures containing *S.*  
*typhimurium* plus *L. acidophilus*. Cultures containing *S.*  
25 *typhimurium* (●) alone reached stationary phase with a  
maximum number of viable cells after about 10 hours of  
growth. Cultures containing a mixture of *S. typhimurium*  
and *L. acidophilus* strain NCFM also resulted in maximum  
numbers of viable cells of *S. typhimurium* (◆) at about  
30 10 hours, although the number of viable cells was  
diminished about 100-fold compared to *S. typhimurium*  
cultured alone. The cell viability of *L. acidophilus*  
strain NCFM (▲) appeared to unaffected by the presence  
of *S. typhimurium*.

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## EXAMPLE 4

FIG. 5 shows the cell viability in cultures  
containing *S. typhimurium* alone (●) and cultures  
containing both *S. typhimurium* (◆) plus *L. acidophilus*  
strain NCFM (▲) as in Example 4 with the exception that  
40 the immunoglobulin composition containing

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5 immunologically active immunoglobulins was added to the  
mixed cultures of *Candida* plus *L. acidophilus* strain  
NCFM in a weight ratio of 1 part of *L. acidophilus*  
strain NCFM to 5 parts of immunoglobulin composition.  
10 These results show that when *S. typhimurium* is cultured  
in the presence of both *L. acidophilus*  
strain NCFM and whey immunoglobulins, the *S. typhimurium*  
failed to produce as many viable cells after 10 hours of  
growth, and the viability of *S. typhimurium* was greatly  
15 reduced through the duration of the experiment as  
compared to growth in co-culture with *L. acidophilus*  
strain NCFM without the immunoglobulins. Therefore, the  
mixture of *L. acidophilus* strain NCFM and the  
immunoglobulin composition greatly decreased the  
20 viability of *S. typhimurium* in vitro compared to growth  
in the presence of either the immunoglobulin composition  
or *L. acidophilus* strain NCFM alone. There appears to  
be an unexpected synergistic effect in diminishing *S.*  
*typhimurium* viability by combining the immunoglobulin  
composition and *L. acidophilus*.

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## EXAMPLE 5

A strain of *E. coli* isolated from human intestine  
was cultured alone, in the presence of *L. acidophilus*  
strain NCFM, and in the presence of both *L. acidophilus*  
30 strain NCFM and the immunoglobulin composition in a  
weight ratio of about 1:10. The results were similar to  
those of Examples 4 and 5, wherein the viability of the  
*E. coli* was greatly diminished in the presence of both  
*L. acidophilus* strain NCFM and the immunoglobulin  
35 composition as compared to in the presence of either  
alone.

The composition of the present invention can be  
used for maintaining gastrointestinal health as well as  
for treating diarrhea, constipation, and other types of  
40 gastrointestinal distress due to infection with  
pathogenic microorganisms such as *E. coli*, *Salmonella*,



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5        *Candida*, rotavirus, and *Cryptosporidium* by orally  
administering an effective amount of the composition.  
The effective amount will vary depending on the size and  
age of the individual, whether the selected effect is to  
maintain gastrointestinal health or to restore  
10        gastrointestinal health from distress due to infection  
with a pathogenic microorganism, the particular  
pathogenic microorganism involved, and the like. A  
person skilled in the art can routinely determine such  
an effective amount. The dry ingredients of the  
15        composition are stirred into water or juice, and the  
resulting suspension is taken by mouth. Preferably,  
dosage is in the range of about 1 to about 100 mg/kg of  
body weight. More preferably, dosage is in the range of  
about 5 to about 50 mg/kg of body weight. Doses of the  
20        bacteria and immunoglobulin-containing composition can  
be divided, wherein two or more administrations of  
divided doses are used to deliver a complete dose.  
Multiple doses can also be administered, but it is  
recommended that daily consumption be limited to 1 to 3  
25        doses.

## EXAMPLE 6

An adult afflicted with diarrhea due to infection  
with *Salmonella* was treated with a composition according  
30        the present invention containing about 5 parts by weight  
of *L. acidophilus* NCFM and about 1 part by weight of an  
immunoglobulin composition comprising concentrated  
immunologically active immunoglobulins purified from  
bovine whey. Doses of about 10 mg/kg of body weight  
35        were taken by mouth 3 times daily by stirring into water  
or juice and drinking the resulting suspension.  
Symptoms began to subside within 24 hours and had  
completely disappeared within 3 days.

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## EXAMPLE 7

A small child afflicted with diarrhea due to rotavirus infection was treated with a composition according the present invention containing 5 parts by weight of *B. adolescentis* and 1 part by weight of an immunoglobulin composition comprising concentrated immunologically active immunoglobulins purified from bovine whey. A dose of about 20 mg/kg of body weight was taken by mouth once daily by stirring into water or juice and drinking the resulting suspension. Symptoms began to subside within 24 hours and had completely disappeared within 3 days.

## EXAMPLE 8

An adult afflicted with diarrhea due to infection with *Cryptosporidium* is treated with a composition according the present invention containing a weight ratio of about 5:1 of *L. acidophilus* NCFM to concentrated immunologically active immunoglobulins purified from bovine whey. Doses of about 10 mg/kg of body weight are taken by mouth 3 times daily by stirring into water or juice and drinking the resulting suspension. Good gastrointestinal health is restored.

## EXAMPLE 9

An adult afflicted with diarrhea due to infection with *Candida* is treated with a composition according to the present invention containing a weight ratio of about 1:5 of *B. adolescentis* to concentrated immunologically active immunoglobulins purified from bovine whey. Doses of about 5 mg/kg of body weight are taken by mouth 3 times daily by stirring into water or juice and drinking the resulting suspension. Good gastrointestinal health is restored.

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## EXAMPLE 10

An adult who averages 10 episodes of gastrointestinal distress per year takes a daily dose of about 50 mg/kg of body weight of a 5:1 weight ratio of the bacteria and immunoglobulin-containing composition according to the present invention with water or juice. In the ensuing year, only 1 episode of gastrointestinal distress is experienced. This example shows that not only can the bacteria and immunoglobulin-containing composition of the present invention be used for treating acute cases of gastrointestinal distress, but is also effective as a dietary supplement in maintaining good gastrointestinal health.

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## EXAMPLE 11

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Various formulations of the bacteria and immunoglobulin-containing composition are tested in treating acute episodes of gastrointestinal distress, as summarized in Table 1.

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Table 1			
Bacteria <sup>a</sup>	Immunoglobulins <sup>a</sup>	Condition	Result <sup>b</sup>
0.2	1	diarrhea	+++
0.2	25	diarrhea	+
5	1	diarrhea	+
5	25	diarrhea	+++
0.1	100	diarrhea	-
100	0.1	diarrhea	-
0.5	2.5	diarrhea	+++
0.5	10	diarrhea	+++
2	2.5	diarrhea	+++
2	10	diarrhea	+++
1	4	constipation	+++
4	1	constipation	++
1	3	gas/cramps	+++
3	1	gas/cramps	++

a Parts by weight.

b Symbols represent a relative scale for restoring gastrointestinal health: +++, excellent; ++, very good; +, good; -, poor.

#### Immunoglobulin and Fiber-Containing Composition

In accordance with a preferred embodiment of the present invention, there is provided an immunoglobulin and fiber-containing composition for use as a dietary supplement. The formulation preferably includes a mixture of an immunoglobulin composition and a soluble dietary fiber selected from the group consisting of inulin, fructo-oligosaccharide, pectin, guar gum, and mixtures thereof in optimal ratios to restore and maintain good gastrointestinal health.

In its most fundamental form, the immunoglobulin and fiber-containing formulations of the present invention include a mixture of about 40 to about 60% by weight of an immunoglobulin composition comprising

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5 concentrated immunologically active immunoglobulins and about 40 to about 60% by weight of soluble dietary fiber selected from the group consisting of inulin, fructo-oligosaccharides, pectin, guar gum, and mixtures thereof.

10 It is also preferable that the formulation contain a beneficial human intestinal microorganism for restoring and maintaining good gastrointestinal health. The beneficial human intestinal microorganism is preferably a member selected from the group consisting of lactobacilli and bifidobacteria. Preferred  
15 lactobacilli include *L. acidophilus*, *L. bulgaricus*, *L. casei*, *L. fermentum*, *L. salivaroos*, *L. brevis*, *L. leichmannii*, *L. plantarum*, and *L. cellobiosus*. *L. acidophilus* is more preferred and *L. acidophilus* strain NCFM is most preferred. Preferred bifidobacteria  
20 include *B. adolescentis*, *B. infantis*, *B. longum*, *B. thermophilum*, and *B. bifidum*. *B. adolescentis* is more preferred. Such beneficial human intestinal bacteria can be added to the base formulation in an amount in the  
25 range of about 0 to about 20% by weight, preferably about 0.1 to about 20% by weight, and more preferably about 5 to about 10% by weight.

It is also preferable that the formulation contain one or more additives for enhancing the activity of the  
30 body's non-immune defense system known as the LP system. Such additives can be added to the base formulation, with or without the presence of optional ingredients, in the following concentrations: lactoperoxidase in an amount in the range of about 0 to about 0.0300% by  
35 weight and thiocyanate salt in an amount in the range of about 0 to about 0.0500% by weight. Preferably, lactoperoxidase is present in an amount in the range of about 0.0001 to about 0.0300% by weight, and thiocyanate salt is present in an amount in the range of about  
40 0.0001 to about 0.0500% by weight.

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5           It is also preferable that the formulation contain  
additional optional ingredients for inhibiting the  
growth of harmful intestinal microorganisms and/or  
promoting the growth of beneficial human intestinal  
microorganisms, such as bifidobacteria. Such additives  
10       can be added to the base formulation, with or without  
the presence of other optional ingredients, in the  
following concentrations: lactoferrin in an amount in  
the range of about 0 to about 0.1000% by weight and  
gluconic acid, its nutritionally acceptable salts, or  
15       mixtures thereof in an amount in the range of about 0 to  
about 10% by weight. Preferably, lactoferrin is present  
in an amount in the range of about 0.0001 to about  
0.1000% by weight, and gluconic acid, its nutritionally  
acceptable salts, or mixtures thereof in an amount in  
20       the range of about 0.1 to about 10% by weight.

          The composition is preferably manufactured in  
powder form by agglomerating the dry, raw material  
ingredients in a suitable agglomerator so as to result  
in a finished product having a uniform composition with  
25       the precise proportions of the components. The bacteria  
are prepared, for example, by culturing in a rich medium  
such as LB, J. Miller, Experiments in Molecular  
Genetics, Cold Spring Harbor Laboratory, Cold Spring  
Harbor, N.Y. (1972), until the late log phase of growth  
30       is reached. The bacteria are then concentrated and  
lyophilized according to standard methods. The  
agglomerated material is then packaged in a suitable  
container. Just prior to consumption, the dry  
composition is reconstituted with water, juice, or the  
35       like to result in a smooth liquid composition that can  
be consumed orally. If desired, the composition can be  
formulated in liquid form. The preferred daily dosage  
of the formula ranges from about 5 to about 15 grams  
based on the powdered composition. The daily dosage can  
40       be ingested in a single serving or divided into various  
servings and taken at intervals. Preferably, the

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5 composition of the present invention is taken between meals.

10 The composition of the present invention can be used for maintaining gastrointestinal health as well as for treating diarrhea, constipation, and other types of gastrointestinal distress due to infection with pathogenic microorganisms such as *E. coli*, *Salmonella*, *Candida*, rotavirus, and *Cryptosporidium* by orally administering an effective amount of the composition. The effective amount will vary depending on the size and age of the individual, whether the selected effect is to maintain gastrointestinal health or to restore gastrointestinal health from distress due to infection with a pathogenic microorganism, the particular pathogenic microorganism involved, and the like. A person skilled in the art can routinely determine such an effective amount. The dry ingredients of the composition are stirred into water or juice, and the resulting suspension is taken by mouth. Preferably, dosage is in the range of about 20 to about 400 mg/kg of body weight. More preferably, dosage is in the range of about 70 to about 215 mg/kg of body weight. Doses of the bacteria and immunoglobulin-containing composition can be divided, wherein two or more administrations of divided doses are used to deliver a complete dose. Multiple doses can also be administered, but it is recommended that daily consumption be limited to 1 to 3 doses.

#### EXAMPLE 12

35 The following formulas represent specific embodiments of the invention. These may be prepared in the manner indicated above by blending together the stated raw ingredients in an agglomerator so as to result in a finished product having uniform composition with the precise proportions of the components as indicated. The agglomerated material is then packaged in a suitable container. In the preferred embodiment,

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5 the formula comprises the following ingredients stated  
in amounts by weight:

Formulation A

	Inulin	50%
10	Immunoglobulin comp.	50%

Formulation B

	Inulin	40%
	Immunoglobulin comp.	40%
15	<i>L. acidophilus</i> NCFM	20%

Formulation C

	Pectin	40%
20	Immunoglobulin comp.	60%

Formulation D

	Guar Gum	20%
25	Pectin	30%
	Immunoglobulin comp.	40%
	<i>B. adolescentis</i>	10%

Formulation E

30	Inulin	30%
	FOS	15%
	Immunoglobulin comp.	49.72%
	<i>L. acidophilus</i> NCFM	2.5%
35	<i>B. adolescentis</i>	2.5%
	Lactoperoxidase	0.03%
	Sodium thiocyanate	0.05%
	Lactoferrin	0.1%
	Gluconic acid	0.1%

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Formulation F

	Inulin	40%
	Pectin	9.98%
45	Immunoglobulin comp.	40%
	<i>B. adolescentis</i>	10%
	Lactoperoxidase	0.02%

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5      Formulation G

	Inulin	10%
	FOS	10%
	Pectin	10%
10	Guar Gum	10%
	Immunoglobulin comp.	52.95%
	<i>L. acidophilus</i> NCFM	7%
	Potassium thiocyanate	0.05%

15      Formulation H

	Inulin	50.9%
	Immunoglobulin comp.	40%
	<i>B. adolescentis</i>	9%
20	Lactoferrin	0.1%

Formulation I

	Inulin	42%
25	Immunoglobulin comp.	40%
	<i>B. adolescentis</i>	8%
	Sodium gluconate	10%

Formulation J

30	Inulin	20%
	FOS	20%
	Pectin	4.44%
	Guar Gum	1%
35	Immunoglobulin comp.	40%
	<i>B. adolescentis</i>	10%
	Lactoperoxidase	0.01%
	Ammonium thiocyanate	0.05%
	Sodium gluconate	4.5%

40

Formulation K

	FOS	36%
	Pectin	3.5%
45	Guar Gum	2.5%
	Immunoglobulin comp.	42%
	<i>L. acidophilus</i> NCFM	10%
	Lactoferrin	0.01%
	Gluconic acid	5.99%

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Formulation L

	Inulin	40%
	Immunoglobulin comp.	40%
55	<i>B. adolescentis</i>	10%
	Lactoperoxidase	0.0001%
	Sodium thiocyanate	0.0001%
	Lactoferrin	0.0001%
	Gluconic acid	10%

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Claims

I claim:

1. An immunoglobulin and fiber-containing composition comprising in percent by weight
  - (a) about 40 to about 60% of an immunoglobulin composition comprising concentrated immunologically active immunoglobulins; and
  - (b) about 40 to about 60% of soluble dietary fiber, wherein said fiber is a member selected from the group consisting of inulin, fructo-oligosaccharides, pectin, guar gum, and mixtures thereof.
2. The composition of claim 1 further comprising about 0.1 to about 20% by weight of a beneficial human intestinal microorganism selected from the group consisting of lactobacilli and bifidobacteria.
3. The composition of claim 1 further comprising about 0.0001% to 0.0500% by weight of thiocyanate salt and about 0 to about 0.0300% by weight of lactoperoxidase.
4. The composition of claim 2 further comprising about 0.0001% to about 0.0500% by weight of thiocyanate salt and about 0 to about 0.0300% by weight of lactoperoxidase.
5. The composition of claim 4 comprising about 0.0001% to about 0.0300% by weight of lactoperoxidase.
6. The composition of claim 1 further comprising about 0.0001% to about 0.1000% of lactoferrin and about 0 to about 10% by weight of a member selected from the group consisting of gluconic acid, its nutritionally acceptable salts, and mixtures thereof.

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5           7. The composition of claim 2 further comprising  
about 0.0001% to about 0.1000% of lactoferrin and about  
0 to about 10% by weight of a member selected from the  
group consisting of gluconic acid, its nutritionally  
acceptable salts, and mixtures thereof.

10

8. The composition of claim 3 further comprising  
about 0.0001% to about 0.1000% of lactoferrin and about  
0 to about 10% by weight of a member selected from the  
group consisting of gluconic acid, its nutritionally  
15 acceptable salts, and mixtures thereof.

9. The composition of claim 4 further comprising  
about 0.0001% to about 0.1000% of lactoferrin and about  
0 to about 10% by weight of a member selected from the  
group consisting of gluconic acid, its nutritionally  
20 acceptable salts, and mixtures thereof.

10. The composition of claim 9 comprising about  
0.1% to about 10% by weight of a member selected from  
the group consisting of gluconic acid, its nutritionally  
25 acceptable salts, and mixtures thereof.

11. The composition of claim 2 wherein said  
beneficial human intestinal microorganism is a member  
30 selected from the group consisting of *Lactobacillus*  
*acidophilus*, *L. bulgaricus*, *L. casei*, *L. fermentum*, *L.*  
*salivaroes*, *L. brevis*, *L. leichmannii*, *L. plantarum*, and  
*L. cellobiosus*.

12. The composition of claim 11 wherein said  
beneficial human intestinal microorganism is  
*Lactobacillus acidophilus*.  
35

13. The composition of claim 12 wherein said  
*Lactobacillus acidophilus* is strain NCFM.  
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5           14. The composition of claim 2 wherein said  
beneficial human intestinal microorganism is a member  
selected from the group consisting of *Bifidobacterium*  
*adolescentis*, *B. infantis*, *B. longum*, *B. thermophilum*,  
and *B. bifidum*.

10

          15. The composition of claim 14 wherein said  
beneficial human intestinal microorganism is *B.*  
*adolescentis*.

15

          16. The composition of claim 1 wherein said  
immunoglobulin composition further comprises a carrier.

          17. The composition of claim 16 wherein said  
carrier comprises at least one member selected from the  
20 group consisting of a carbohydrate and a lipid, wherein  
said carbohydrate is capable of being an energy source  
for a beneficial human intestinal microorganism and said  
lipid aids in reconstitution of said immunoglobulin  
composition.

25

          18. The composition of claim 17 wherein said  
carbohydrate comprises maltodextrin and said lipid  
comprises lecithin.

30

          19. The composition of claim 1 wherein said  
immunoglobulin composition is purified from a source  
selected from the group consisting of milk, milk  
products, and whey.

35

          20. The composition of claim 19 wherein said  
source is bovine.

          21. A bacteria and immunoglobulin-containing  
composition for promoting gastrointestinal health  
40 comprising

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5 (a) an effective amount of a beneficial human intestinal microorganism; and

(b) an effective amount of an immunoglobulin composition comprising concentrated immunologically active immunoglobulins.

10

22. The composition of claim 21 wherein said beneficial human intestinal microorganism is selected from the group consisting of lactobacilli and bifidobacteria.

15

23. The composition of claim 22 wherein the weight ratio of beneficial human intestinal microorganism to immunologically active immunoglobulins is in the range of about 20:1 to about 1:20.

20

24. The composition of claim 23 wherein weight ratio of beneficial human intestinal microorganism to immunologically active immunoglobulins is in the range of about 1:5 to about 10:1.

25

25. The composition of claim 24 wherein said beneficial human intestinal microorganism is a lactobacillus.

30

26. The composition of claim 25 wherein said lactobacillus is selected from the group consisting of *L. acidophilus*, *L. bulgaricus*, *L. casei*, *L. fermentum*, *L. salivaroos*, *L. brevis*, *L. leichmannii*, *L. plantarum*, and *L. cellobiosus*.

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27. The composition of claim 26 wherein said lactobacillus is *Lactobacillus acidophilus*.

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28. The composition of claim 27 wherein said *Lactobacillus acidophilus* is strain NCFM.

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5           29. The composition of claim 24 wherein said  
beneficial human intestinal microorganism is a  
bifidobacterium.

10           30. The composition of claim 29 wherein said  
bifidobacterium is selected from the group consisting of  
*Bifidobacterium adolescentis*, *B. infantis*, *B. longum*, *B.*  
*thermophilum*, and *B. bifidum*.

15           31. The composition of claim 30 wherein said  
bifidobacterium is *B. adolescentis*.

          32. The composition of claim 21 wherein said  
immunoglobulin composition further comprises a carrier.

20           33. The composition of claim 32 wherein said  
carrier comprises at least one member selected from the  
group consisting of a carbohydrate and a lipid, wherein  
said carbohydrate is capable of being an energy source  
for said beneficial human intestinal microorganism and  
25           said lipid aids in reconstitution of said immunoglobulin  
composition.

          34. The composition of claim 35 wherein said  
carbohydrate comprises maltodextrin and said lipid  
30           comprises lecithin.

          35. The composition of claim 21 wherein said  
immunoglobulin composition is purified from a source  
selected from the group consisting of milk, milk  
35           products, and whey.

          36. The composition of claim 35 wherein said  
source is bovine.

40           37. A method of restoring and maintaining  
gastrointestinal health comprising the step of orally

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5 administering a bacteria and immunoglobulin-containing  
composition comprising an effective amount of a  
beneficial human intestinal microorganism and an  
effective amount of an immunoglobulin composition  
10 comprising concentrated immunologically active  
immunoglobulins.

38. The method of claim 37 wherein said beneficial  
human intestinal microorganism is a member selected from  
the group consisting of lactobacilli and bifidobacteria.

15

39. The method of claim 38 wherein the weight  
ratio of beneficial human intestinal microorganism to  
immunologically active immunoglobulins is in the range  
of about 20:1 to about 1:20.

20

40. The method of claim 39 wherein the weight  
ratio of beneficial human intestinal microorganism to  
immunologically active immunoglobulins is in the range  
of about 1:5 to about 10:1.

25

41. The method of claim 40 wherein said  
lactobacilli are selected from the group consisting of  
*L. acidophilus*, *L. bulgaricus*, *L. casei*, *L. fermentum*,  
*L. salivaro*es, *L. brevis*, *L. leichmannii*, *L. plantarum*,  
30 and *L. cellobiosus* and said bifidobacteria are selected  
from the group consisting of *Bifidobacterium*  
*adolescentis*, *B. infantis*, *B. longum*, *B. thermophilum*,  
and *B. bifidum*.

35

42. The method of claim 41 wherein said beneficial  
human intestinal microorganism is *Lactobacillus*  
*acidophilus*.

40

43. The method of claim 41 wherein said beneficial  
human intestinal microorganism is *B. adolescentis*.

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5           44. The method of claim 41 wherein said immunoglobulin composition is purified from a source selected from the group consisting of bovine milk, milk products, and whey.

10           45. A method of restoring and maintaining gastrointestinal health comprising the step of orally administering an effective amount of an immunoglobulin and fiber-containing composition for promoting gastrointestinal health comprising in percent by weight

15           (a) about 40 to about 60% of an immunoglobulin composition comprising concentrated immunologically active immunoglobulins; and

20           (b) about 40 to about 60% of soluble dietary fiber, wherein said fiber is a member selected from the group consisting of inulin, fructo-oligosaccharides, pectin, guar gum, and mixtures thereof.

25           46. The method of claim 45 wherein said immunoglobulin and fiber-containing composition further comprises about 0.1 to about 20% by weight of a beneficial human intestinal microorganism selected from the group consisting of lactobacilli and bifidobacteria.

30           47. The method of claim 46 wherein said lactobacilli are selected from the group consisting of *Lactobacillus acidophilus*, *L. bulgaricus*, *L. casei*, *L. fermentum*, *L. salivaro*es, *L. brevis*, *L. leichmannii*, *L. plantarum*, and *L. cellobiosus* and said bifidobacteria are selected from the group consisting of

35           *Bifidobacterium adolescentis*, *B. infantis*, *B. longum*, *B. thermophilum*, and *B. bifidum*.

40           48. The method of claim 47 wherein said beneficial human intestinal microorganism is *Lactobacillus acidophilus*.



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5           49. The method of claim 47 wherein said beneficial human intestinal microorganism is *B. adolescentis*.

10           50. The method of claim 45 wherein said immunoglobulin and fiber-containing composition further comprises about 0.0001% to 0.0500% by weight of thiocyanate salt and about 0 to about 0.0300% by weight of lactoperoxidase.

15           51. The method of claim 45 wherein said immunoglobulin and fiber-containing composition further comprises about 0.0001% to about 0.1000% of lactoferrin and about 0 to about 10% by weight of a member selected from the group consisting of gluconic acid, its nutritionally acceptable salts, and mixtures thereof.

20           52. The method of claim 45 wherein said immunoglobulin composition is purified from a source selected from the group consisting of bovine milk, milk products, and whey.

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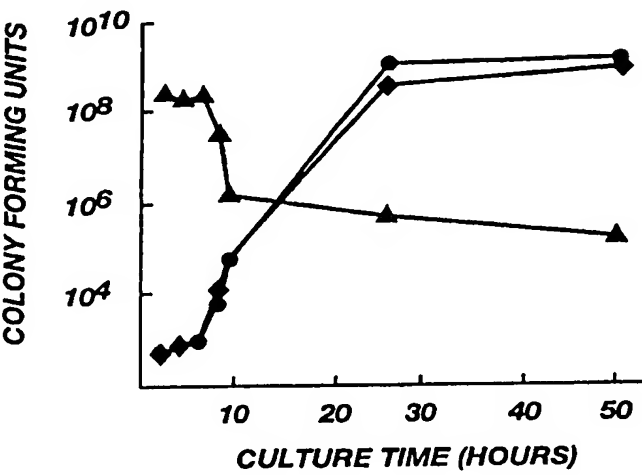


Fig. 1

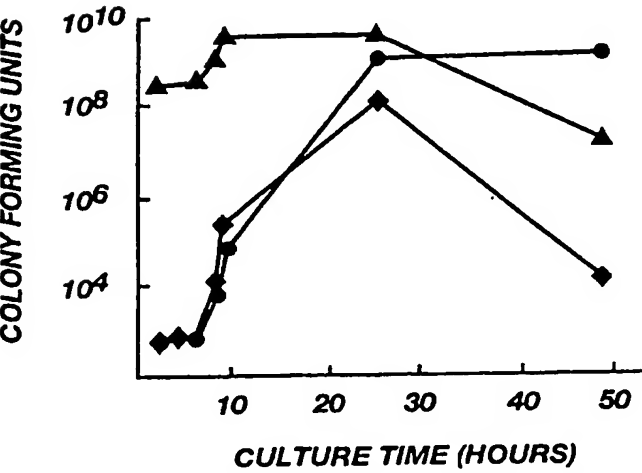


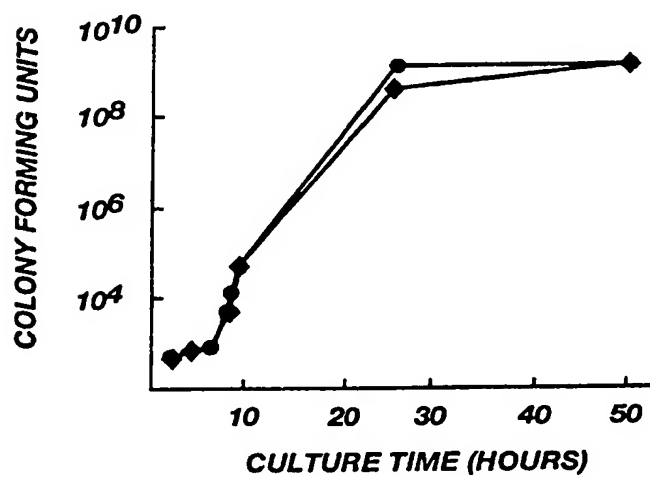
Fig. 2

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**Fig. 3**

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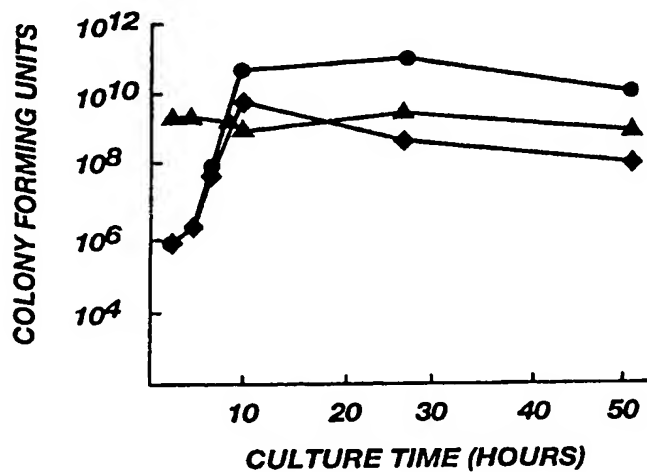


Fig. 4

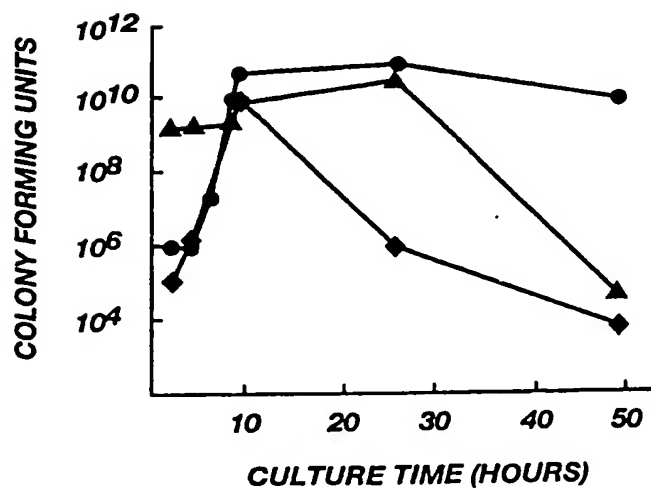


Fig. 5

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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US95/13905

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A61K 35/00, 35/20, 39/02, 39/07, 39/395, 39/40, 39/42, 47/00

US CL :Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,816,252 (STOTT ET AL.) 28 MARCH 1989, see entire document.	1-52
A	US, A, 4,977,137 (NICHOLS ET AL.) 11 DECEMBER 1990, see entire document.	1-52
A	US, A, 5,240,909 (NITSCHKE) 31 AUGUST 1993, see entire document.	1-52
A	Journal of Food Protection, Volume 40, Number 12, issued December 1977, Gilliland et al., "Antagonistic Action of <i>Lactobacillus acidophilus</i> Toward Intestinal and Foodborne Pathogens in Associative cultures", pages 820-823, see entire document.	1-52

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

<p>* Special categories of cited documents:</p>		<p>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p>	
*A*	document defining the general state of the art which is not considered to be of particular relevance	*X*	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E*	earlier document published on or after the international filing date	*Y*	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L*	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G*	document member of the same patent family
*O*	document referring to an oral disclosure, use, exhibition or other means		
*P*	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

25 JANUARY 1996

Date of mailing of the international search report

08 FEB 1996

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Box PCT  
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

NATHAN M. NUTTER jd

Telephone No. (703) 308-1235

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US95/13905

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Journal of Dairy Science, Volume 73, Number 4, issued 1990, Gilliland et al., "Factors to Consider When Selecting a Culture of <i>Lactobacillus Acidophilus</i> as a Dietary Adjunct to Produce a Hypocholesterolemic Effect in Humans", pages 905-911, see entire document.	1-52
A	Annals of Internal Medicine, Volume 116, Number 5, issued 01 March 1992, Hilton et al., "Ingestion of Yogurt Containing <i>Lactobacillus Acidophilus</i> as Prophylaxis for Candidal Vaginitis", pages 353-357, see entire document.	1-52
A	New England Journal of Medicine, Volume 318, Number 19, issued 12 May 1988, Tacket et al., "Protection by Milk Immunoglobulin Concentrate Against Oral Challenge With Enterotoxigenic <i>Escherichia Coli</i> ", pages 1240-1243, see entire document.	1-52

**INTERNATIONAL SEARCH REPORT**

International application No.  
PCT/US95/13905

**A. CLASSIFICATION OF SUBJECT MATTER:**

US CL :

424/93.4, 93.45, 130.1, 143.1, 145.1, 147.1, 148.1, 149.1, 150.1, 151.1, 157.1, 158.1, 159.1, 161.1, 195.1, 234.1,  
499, 500, 535, 809; 514/2, 439, 441, 445, 777, 867

**B. FIELDS SEARCHED**

Minimum documentation searched

Classification System: U.S.

424/93.4, 93.45, 130.1, 133.1, 135.1, 135.6, 141.1, 143.1, 145.1, 147.1, 148.1, 149.1, 150.1, 151.1, 157.1, 158.1,  
159.1, 161.1, 195.1, 234.1, 499, 500, 535, 809; 514/2, 439, 441, 445, 484, 485, 777, 867